UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

LIONRA TECHNOLOGIES LIMITED, *Plaintiff,* v. APPLE INC. *Defendant.*	Case No. 6:22-cv-00351-ADA **JURY TRIAL DEMANDED**

FIRST AMENDED COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Lionra Technologies Limited ("Lionra") files this first amended complaint against Apple Inc. ("Apple" or "Defendant"), alleging infringement of U.S. Patent No. 7,260,141. The Accused Products are mobile devices that support 5G cellular communications, made, used, offered for sale, sold, imported by Defendant in the United States and supplied by Defendant to its customers and integrated into electronic devices sold in the United States.

Plaintiff Lionra and the Patents-in-Suit

1. Plaintiff Lionra is a technology licensing company organized under the laws of Ireland, with its headquarters at The Hyde Building, Suite 23, The Park, Carrickmines, Dublin 18, Ireland.

2. Lionra is the owner of U.S. Patent No. 7,260,141, entitled "Integrated Beamformer/Modem Architecture," which issued August 21, 2007 (the "'141 patent"). A copy of the '141 patent is attached to this complaint as Exhibit 1.

Defendant and the Accused Products

3. On information and belief, Defendant Apple Inc. is a California corporation with regular and established places of business in this district.

4. The Accused Products are mobile devices and base stations that support 5G cellular ultra-wideband communications, made, used, offered for sale, sold, imported by Defendant in the United States, including without limitation the Apple iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone SE, iPad Air, iPad mini, and iPad Pro.

Jurisdiction and Venue

5. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has original subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

6. This Court has personal jurisdiction over Defendant in this action because Defendant has established minimum contacts with the United States as a whole such that the exercise of jurisdiction would not offend traditional notions of fair play and substantial justice. Defendant has purposefully directed activities at the United States, in particular, directing Accused Products for sale to customers and distributors within the United States (including within this District) and engaging in sales and marketing efforts to generate and support such sales. Defendant has committed acts of infringement of Lionra's patents giving rise to this action, such as by supplying to distributors and consumer device retailers the Accused Products in this District, including without limitation the Apple iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPhone 13, iPhone 13 Mini, iPhone 13 Pro, iPhone 13 Pro Max, iPhone SE, iPad Air, iPad mini, and iPad Pro, each accused of infringement in this case. Defendant, directly and through subsidiaries, intermediaries, and third parties, has committed and continues to commit acts of infringement in this District by, among other things, making, using, offering to sell, selling, and importing products that infringe the '141 patent.

7. Venue is proper in this District under 28 U.S.C. §§ 1391 and 1400(b). Defendant has committed acts of infringement in this District and has regular and established places of business in this District, including its office located at 12545 Riata Vista Cir, Austin, TX 78727; 2901 S. Capital of Texas Hwy, Austin, TX 78746; 3121 Palm Way, Austin, TX 78758; 8401 Gateway Boulevard West, El Paso, TX 79925; 15900 La Cantera Parkway, San Antonio, TX 78256; and 7400 San Pedro Avenue, San Antonio, TX 78216.

8. Venue is proper in this district under 28 U.S.C. §1400(b) and 28 U.S.C. §§ 1391(c). Defendant has regular and established places of business in this district as set forth above.

Count 1 – Claim for infringement of the '141 patent.

9. Lionra incorporates by reference each of the allegations in paragraphs 1–8 above and further alleges as follows:

10. On August 21, 2007, the United States Patent and Trademark Office issued U.S. Patent No. 7,260,141, entitled "Integrated Beamformer/Modem Architecture." Ex. 1.

11. Lionra is the owner of the '141 patent with full rights to pursue recovery of royalties for damages for infringement, including full rights to recover past and future damages.

12. Each claim of the '141 patent is valid, enforceable, and patent-eligible.

13. Lionra and its predecessors in interest have satisfied the requirements of 35 U.S.C. § 287(a) with respect to the '141 patent, and Lionra is entitled to damages for Defendant's past infringement.

14. Defendant has directly infringed (literally and equivalently) the '141 patent by making, using, selling, offering for sale, or importing products that infringe the claims of the '141 patent without a license or permission from Lionra. These products include without limitation the Apple iPhone 12, iPhone 12 Mini, iPhone 12 Pro, iPhone 12 Pro Max, iPhone 13, iPhone 13 Mini, iPhone

13 Pro, iPhone 13 Pro Max, iPhone SE, iPad Air, iPad mini, and iPad Pro, which infringe at least claim 1 of the '141 patent.

15. On information and belief, the Accused Products include an "apparatus for modulating and demodulating signals transmitted and received via an electronically steerable phased array antenna comprising a plurality of antenna elements."

16. For example, Apple specifically advertises that the U.S. models of the iPhone 12 Pro can communicate with cellular networks utilizing the 3GPP 5G NR ("New Radio") protocols, utilizing frequency bands both in Frequency Range 1 and Frequency Range 2:

> **Cellular and Wireless**
>
> - **Model A2341***
>
> 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
> 5G NR mmWave (Bands n260, n261)
> FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
> TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
> CDMA EV-DO Rev. A (800, 1900 MHz)
> UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
> GSM/EDGE (850, 900, 1800, 1900 MHz)
>
> - **Model A2342***
>
> 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
> 5G NR mmWave (Bands n260, n261)
> FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
> TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
> CDMA EV-DO Rev. A (800, 1900 MHz)
> UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
> GSM/EDGE (850, 900, 1800, 1900 MHz)

(https://support.apple.com/kb/SP831?locale=en_US; *see* https://en.wikipedia.org/wiki/5G_NR_frequency_bands).

17. For products that advertise the ability to communicate with 5G NR cellular networks to successfully provide that advertised capability, they must generate radio signals and/or receive radio signals that have been generated according to the various 3GPP technical specification documents that define 5G NR cellular network operation, including 3GPP TS 38.201 ("NR; Physical Layer; General description"), 3GPP TS 38.211 ("NR; Physical channels and modulation"), 3GPP TS 38.214 ("NR; Physical layer procedures for data"), 3GPP TS 38.300 ("NR, NR and NG-RAN

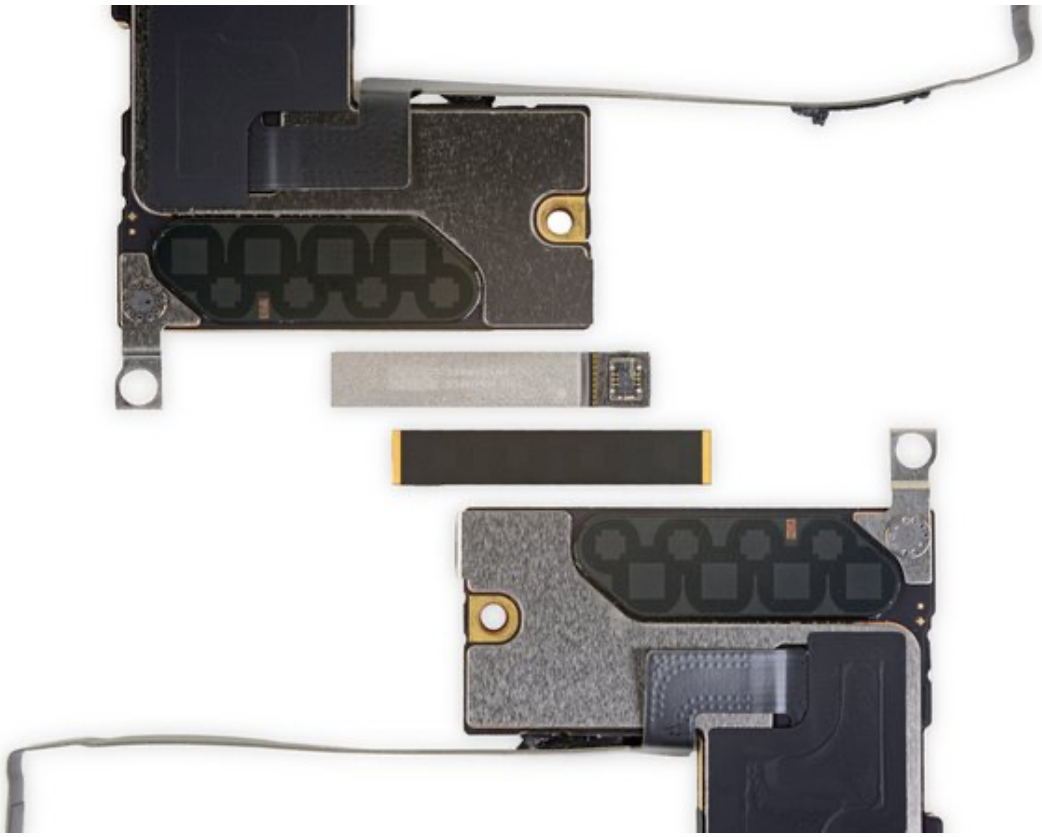
Overall Description; Stage 2"). On information and belief, the U.S. models of Apple's Accused Products do indeed communicate with 3GPP 5G NR cellular networks as advertised, and accordingly they generate radio signals and/or receive radio signals that have been generated according to the foregoing 3GPP technical specifications and related standards documents.

18. For example, 5G NR signals must be modulated and demodulated:

> ## 5.4 Modulation and upconversion
>
> Modulation and upconversion to the carrier frequency f_0 of the complex-valued OFDM baseband signal for antenna port p, subcarrier spacing configuration μ, and OFDM symbol l in a subframe assumed to start at $t = 0$ is given by
>
> - for PRACH
>
> $$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)e^{j2\pi f_0 t}\right\}$$
>
> - for RIM-RS
>
> $$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)e^{j2\pi f_0^{\mathrm{RIM}}\left(t-t_{\mathrm{start},l_0}^{\mu}-N_{\mathrm{CP}}^{\mathrm{RIM}}T_c\right)}\right\}$$
>
> where f_0^{RIM} is the configured reference point for RIM-RS;
>
> - for all other channels and signals
>
> $$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)\cdot e^{j2\pi f_0\left(t-t_{\mathrm{start},l}^{\mu}-N_{\mathrm{CP},l}^{\mu}T_c\right)}\right\}$$

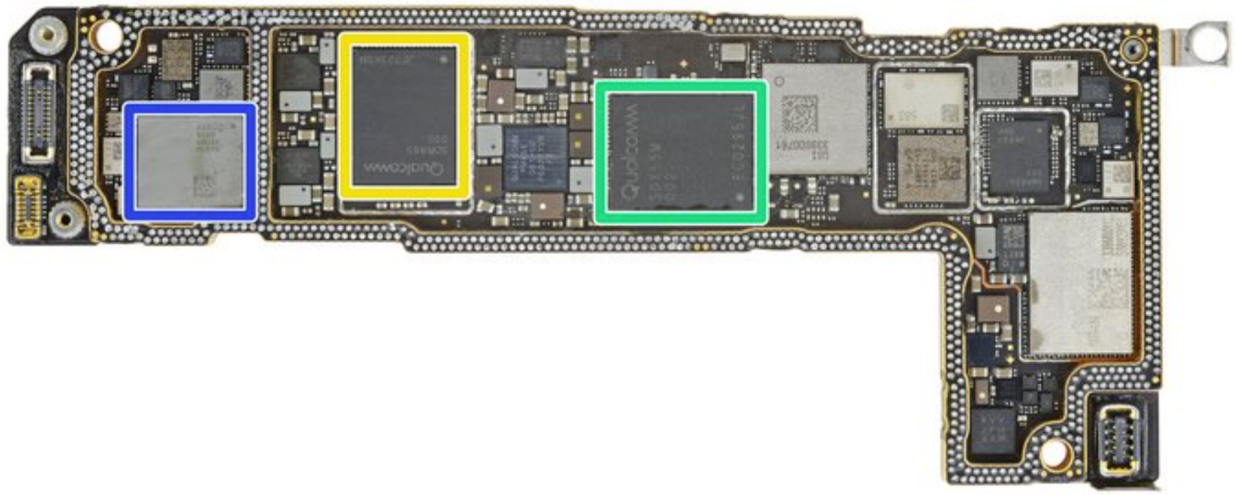
(3GPP TS 38.211 V16.8.0, § 5.4.) Accordingly, the Accused Products modulate 5G NR signals that they transmit. Likewise, the Accused Products receive 5G NR signals that have previously been modulated, and they demodulate those signals as part of the process of extracting the information that they contain.

19. As a further example, on information and belief the iPhone 12 Pro contains electronically steerable phased array antennas:



(https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669.) As indicated in this ifixit.com teardown report, these electronically steerable phased array antennas include "5G mmWave antenna modules." (*Id.*) According to the iPhone 12 Pro specifications quoted above, the only cellular standard for which the product would utilize an mmWave antenna is 5G NR, in Frequency Range 2. Apple U.S. Patent Publication 2021/0167487, Figure 2 depicts an iPhone-like device with "antenna arrays" 282 and 284. The Apple patent specification explains that these antenna arrays "may be adapted to conduct millimeter wave 5G communications and may be adapted to use or be used with beam-forming or other techniques to adapt signal reception depending on the use case." (*Id.* ¶ 147)

20. On information and belief, the Accused Products include "a baseband modulator configured to modulate outbound digital baseband signals to be transmitted via the phased array antenna":



In the iPhone 12 Pro, this baseband modulator includes at least portions of the Qualcomm SDX55M "5G Modem-RF System" integrated circuit, identified with a green rectangle in the teardown image above. (https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669). As is well-known, the term "modem" refers to a "modulator-demodulator" and the 3GPP technical specifications describe how "OFDM baseband signal[s]" must be "modulat[ed]" in order to be transmitted in a 5G NR cellular network:

5.4 Modulation and upconversion

Modulation and upconversion to the carrier frequency f_0 of the complex-valued OFDM baseband signal for antenna port p, subcarrier spacing configuration μ, and OFDM symbol l in a subframe assumed to start at $t = 0$ is given by

- for PRACH

$$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)e^{j2\pi f_0 t}\right\}$$

- for RIM-RS

$$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)e^{j2\pi f_0^{\mathrm{RIM}}\left(t-t_{\mathrm{start},l_0}^{\mu}-N_{\mathrm{CP}}^{\mathrm{RIM}}T_c\right)}\right\}$$

  where f_0^{RIM} is the configured reference point for RIM-RS;

- for all other channels and signals

$$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)\cdot e^{j2\pi f_0\left(t-t_{\mathrm{start},l}^{\mu}-N_{\mathrm{CP},l}^{\mu}T_c\right)}\right\}$$

(3GPP TS 38.211 V16.8.0, § 5.4.)

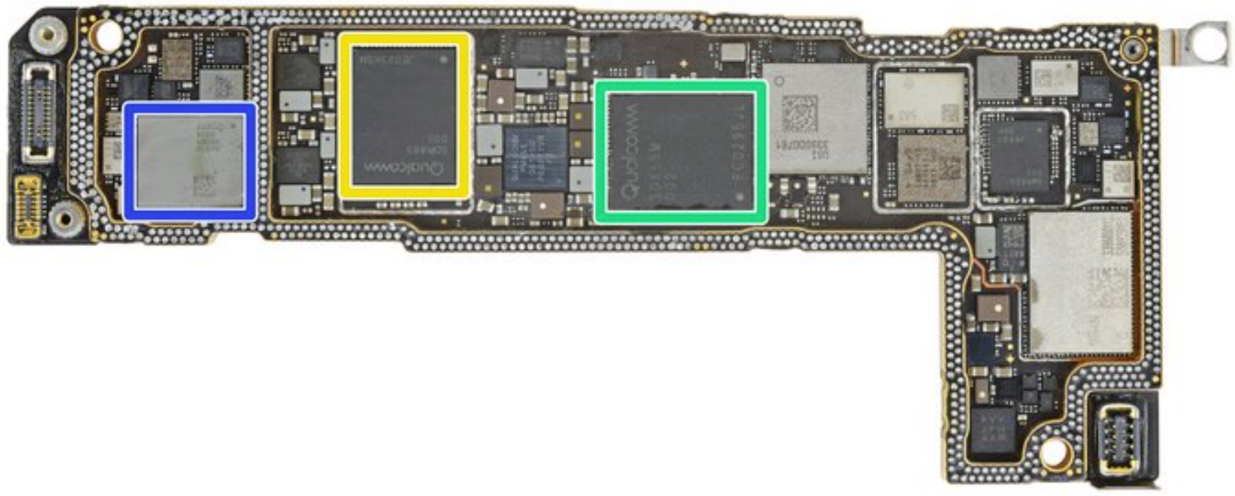
7.3.1.5 Mapping to virtual resource blocks

The UE shall, for each of the antenna ports used for transmission of the physical channel, assume the block of complex-valued symbols $y^{(p)}(0), \ldots, y^{(p)}(M_{\text{symb}}^{\text{ap}} - 1)$ conform to the downlink power allocation specified in [6, TS 38.214] and are mapped in sequence starting with $y^{(p)}(0)$ to resource elements $(k', l)_{p,\mu}$ in the virtual resource blocks assigned for transmission which meet all of the following criteria:

- they are in the virtual resource blocks assigned for transmission;
- the corresponding physical resource blocks are declared as available for PDSCH according to clause 5.1.4 of [6, TS 38.214];

(3GPP TS 38.211 V16.8.0, § 7.3.1.5.)

21. On information and belief, the Accused Products include "a baseband demodulator configured to demodulate incoming digital baseband signals generated from signals received via the phased array antenna":



In the iPhone 12 Pro, this baseband demodulator includes at least portions of the Qualcomm SDX55M "5G Modem-RF System" integrated circuit, identified with a green rectangle in the teardown image above. (https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669). As is well-known, the term "modem" refers to a "modulator-demodulator" and the 3GPP technical specifications describe how "OFDM baseband signal[s]" must be "modulat[ed]" in order to be transmitted in a 5G NR cellular network:

5.4 Modulation and upconversion

Modulation and upconversion to the carrier frequency f_0 of the complex-valued OFDM baseband signal for antenna port p, subcarrier spacing configuration μ, and OFDM symbol l in a subframe assumed to start at $t = 0$ is given by

- for PRACH

$$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)e^{j2\pi f_0 t}\right\}$$

- for RIM-RS

$$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)e^{j2\pi f_0^{\mathrm{RIM}}\left(t-t_{\mathrm{start},l_0}^{\mu}-N_{\mathrm{CP}}^{\mathrm{RIM}}T_c\right)}\right\}$$

  where f_0^{RIM} is the configured reference point for RIM-RS;

- for all other channels and signals

$$\mathrm{Re}\left\{s_l^{(p,\mu)}(t)\cdot e^{j2\pi f_0\left(t-t_{\mathrm{start},l}^{\mu}-N_{\mathrm{CP},l}^{\mu}T_c\right)}\right\}$$

(3GPP TS 38.211 V16.8.0, § 5.4.)

6.2 Physical resources

The frame structure and physical resources the UE shall use when transmitting in the uplink transmissions are defined in Clause 4.

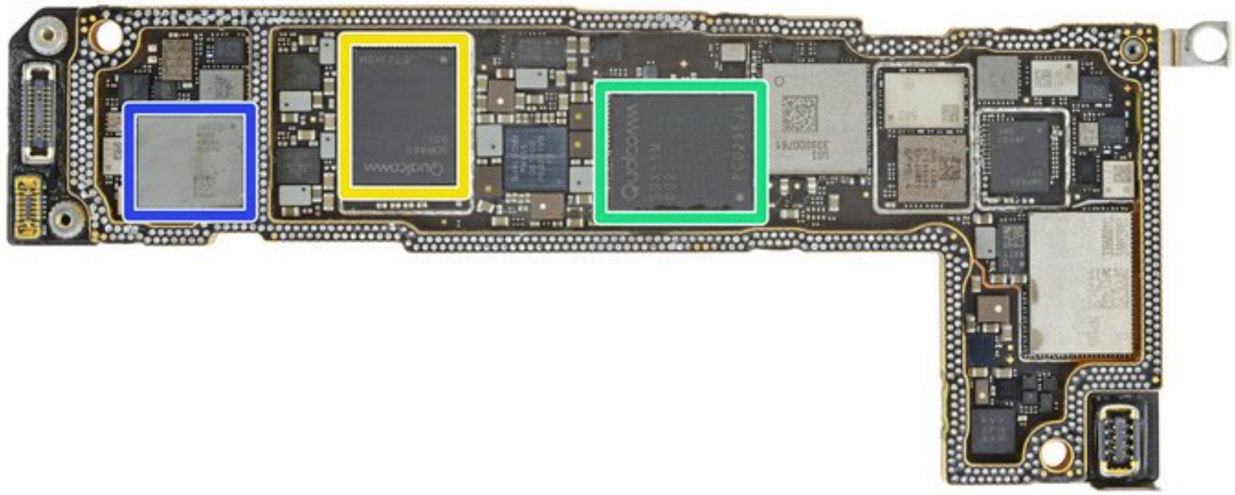
The following antenna ports are defined for the uplink:

- Antenna ports starting with 0 for demodulation reference signals for PUSCH
- Antenna ports starting with 1000 for SRS, PUSCH
- Antenna ports starting with 2000 for PUCCH
- Antenna port 4000 for PRACH

If PUSCH repetition Type B as described in clause 6.1 of [6, TS38.214] is applied to a physical channel, the UE transmission shall be such that the channel over which a symbol on the antenna port used for uplink transmission is conveyed can be inferred from the channel over which another symbol on the same antenna port is conveyed if the two symbols correspond to the same actual repetition of a PUSCH transmission with repetition Type B.

(3GPP TS 38.211 V16.8.0, § 6.2.) Because the signals received by the phased antenna arrays of the Accused Products have been generated by modulating a baseband signal, according to the 3GPP 5G NR specifications, the baseband demodulator must demodulate those signals as part of the process of extracting the information that they contain.

22. On information and belief, the Accused Products include "a shared baseband processor configured to receive digital baseband signals including the modulated outbound digital baseband signals and the incoming digital baseband signals, said shared baseband processor applying a single phase adjustment to each of the digital baseband signals to jointly account for both beamforming phase rotation and carrier phase rotation of individual antenna elements":



In the iPhone 12 Pro, this shared baseband processor includes at least portions of the Qualcomm SDX55M "5G Modem-RF System" integrated circuit, identified with a green rectangle in the teardown image above, which is also referred to as a "baseband chipset." (https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669; https://www.theiphonewiki.com/wiki/SDX55M).

23. Signals transmitted on 5G NR cellular networks utilize phase rotations to account for beam-forming phase rotation and carrier phase rotation. For example, a phase rotation of a signal can be represented mathematically by multiplying the signal by $e^{j\theta}$, where j is a square root of –1 and θ is a phase in radians. (*See* https://en.wikipedia.org/wiki/Phasor.) For 3GPP 5G NR transmitted signals, a beamforming phase rotation is applied to each individual antenna element, as part of the definition of the baseband signal:

5.3 OFDM baseband signal generation

5.3.1 OFDM baseband signal generation for all channels except PRACH and RIM-RS

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port p and subcarrier spacing configuration μ for OFDM symbol $l \in \left\{0,1,\ldots,N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\right\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \begin{cases} \bar{s}_l^{(p,\mu)}(t) & t_{\text{start},l}^{\mu} \le t < t_{\text{start},l}^{\mu} + T_{\text{symb},l}^{\mu} \\ 0 & \text{otherwise} \end{cases}$$

$$\bar{s}_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} e^{j2\pi\left(k + k_0^{\mu} - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^{\mu} T_c - t_{\text{start},l}^{\mu}\right)}$$

$$k_0^{\mu} = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$

$$T_{\text{symb},l}^{\mu} = \left(N_{\text{u}}^{\mu} + N_{\text{CP},l}^{\mu}\right) T_c$$

where $t = 0$ at the start of the subframe.

(3GPP TS 38.211 V16.8.0, § 5.3.1.) In addition, for channels other than PRACH, a carrier phase rotation is applied to each individual antenna element, as part of the definition of the digital base-band signal:

5.4 Modulation and upconversion

Modulation and upconversion to the carrier frequency f_0 of the complex-valued OFDM baseband signal for antenna port p, subcarrier spacing configuration μ, and OFDM symbol l in a subframe assumed to start at $t = 0$ is given by

- for PRACH

$$\text{Re}\left\{s_l^{(p,\mu)}(t) e^{j2\pi f_0 t}\right\}$$

- for RIM-RS

$$\text{Re}\left\{s_l^{(p,\mu)}(t) e^{j2\pi f_0^{\text{RIM}}\left(t - t_{\text{start},l_0}^{\mu} - N_{\text{CP}}^{\text{RIM}} T_c\right)}\right\}$$

  where f_0^{RIM} is the configured reference point for RIM-RS;

- for all other channels and signals

$$\text{Re}\left\{s_l^{(p,\mu)}(t) \cdot e^{j2\pi f_0\left(t - t_{\text{start},l}^{\mu} - N_{\text{CP},l}^{\mu} T_c\right)}\right\}$$

(3GPP TS 38.211 V16.8.0, § 5.4.) On information and belief, the shared baseband processor in the Accused Products applies a single phase adjustment to each of the modulated outbound digital baseband signals to jointly account for both beamforming phase rotation and carrier phase rotation of individual antenna elements, literally and/or under the doctrine of equivalents:

6.3.3.2 Mapping to physical resources

The preamble sequence shall be mapped to physical resources according to

$$a_k^{(p,\mathrm{RA})} = \beta_{\mathrm{PRACH}} y_{u,v}(k)$$
$$k = 0,1,\ldots,L_{\mathrm{RA}}-1$$

where β_{PRACH} is an amplitude scaling factor in order to conform to the transmit power specified in [5, TS38.213], and $p = 4000$ is the antenna port. Baseband signal generation shall be done according to clause 5.3 using the parameters in Table 6.3.3.1-1 or Table 6.3.3.1-2 with $\bar{k}$ given by Table 6.3.3.2-1.

. . .

For operation with shared spectrum channel access, for $L_{RA} = 139$, a UE expects to be provided with higher-layer parameter *msg1-FrequencyStart* or *msgA-RO-FrequencyStart* if configured, and higher-layer parameter *msg1-FDM* or *msgA-RO-FDM* if configured, such that a random access preamble is confined within a single RB set. The UE assumes that the RB set is defined as when the UE is not provided *intraCellGuardBandsPerSCS* for an UL carrier as described in Clause 7 of [6, TS 38.214].

For operation with shared spectrum channel access, for $L_{RA} = 571$ or 1151 and Type-2 random access, a UE expects to be provided with higher-layer parameter *msgA-RO-FDM* equals to one.

(3GPP TS 38.211 V16.8.0, § 6.3.3.2.)

For operation with shared spectrum channel access where a UE is performing uplink transmission with configured grants in contiguous OFDM symbols on all resource blocks of an RB set, for the first such UL transmission the UE determines a duration of a cyclic prefix extension T_{ext} to be applied for transmission according to [4, TS 38.211] where the index for Δ_i [4, TS 38.211] is chosen randomly from a set of values configured by higher layers according to the following rule:

- If the first such UL transmission is within a channel occupancy initiated by the gNB (defined in Clause 4 of [16, TS 37.213]), the set of values is determined by *cg-StartingFullBW-InsideCOT*;
- otherwise, the set of values is determined by *cg-StartingFullBW-OutsideCOT*.

For operation with shared spectrum channel access where a UE is performing uplink transmission with configured grants in contiguous OFDM symbols on fewer than all resource blocks of an RB set, for the first such UL transmission the UE determines a duration of a cyclic prefix extension T_{ext} to be applied for transmission according to [4, TS 38.211] according to the following rule:

- If the first such UL transmission is within a channel occupancy initiated by the gNB (defined in Clause 4 of [16, TS 37.213]), the index for Δ_i [4, TS 38.211] is equal to *cg-StartingPartialBW-InsideCOT*;
- otherwise, the index for Δ_i [4, TS 38.211] is equal to *cg-StartingPartialBW-OutsideCOT*.

(3GPP TS 38.214 V16.8.0, § 6.1.2.3.)

24. Likewise, the shared baseband processor of the Accused Products must apply phase adjustments to the digital baseband version of the radio signals received from a 5G NR cellular network to account for beamforming phase rotation and for carrier phase rotation. For example, the Accused Products are UE ("user equipment") which must apply beamforming phase rotations to measure individual beams received from cellular base stations:

9.2.4 Measurements

In RRC_CONNECTED, the UE measures multiple beams (at least one) of a cell and the measurements results (power values) are averaged to derive the cell quality. In doing so, the UE is configured to consider a subset of the detected beams. Filtering takes place at two different levels: at the physical layer to derive beam quality and then at RRC level to derive cell quality from multiple beams. Cell quality from beam measurements is derived in the same way for the serving cell(s) and for the non-serving cell(s). Measurement reports may contain the measurement results of the *X* best beams if the UE is configured to do so by the gNB.

(3GPP TS 38.300 V16.8.0, § 9.2.4.) As noted above, Apple U.S. Patent Publication 2021/0167487, Figure 2 depicts an iPhone-like device with "antenna arrays" 282 and 284. The Apple patent specification explains that these antenna arrays "may be adapted to use or be used with beam-forming or other techniques to adapt signal reception depending on the use case." (*Id.* ¶ 147)

25. In addition, the Accused Products must account for carrier phase rotation. The 3GPP technical specification documents describe "phase-tracking reference signals" that are inserted into the transmitted signals specifically for the receiver device (such as the Accused Products) to utilize to measure the carrier phase rotation which it must account for:

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are being used, the block of complex-valued symbols $x^{(0)}(0), \ldots, x^{(0)}\left(M_{\text{symb}}^{\text{layer}} - 1\right)$ shall be divided into sets, each set corresponding to one OFDM symbol, and where set l contains $M_{\text{sc}}^{\text{PUSCH}} - \varepsilon_l N_{\text{samp}}^{\text{group}} N_{\text{group}}^{\text{PTRS}}$ symbols and is mapped to the complex-valued symbols $\tilde{x}^{(0)}(lM_{\text{sc}}^{\text{PUSCH}} + i')$ corresponding to OFDM symbol l prior to transform precoding, with $i' \in \{0,1,\ldots, M_{\text{sc}}^{\text{PUSCH}} - 1\}$ and $i' \neq m$. The index m of PT-RS samples in set l, the number of samples per PT-RS group $N_{\text{samp}}^{\text{group}}$, and the number of PT-RS groups $N_{\text{group}}^{\text{PT-RS}}$ are defined in clause 6.4.1.2.2.2. The quantity $\varepsilon_l = 1$ when OFDM symbol l contains one or more PT-RS samples, otherwise $\varepsilon_l = 0$.

(3GPP TS 38.211 V16.8.0, § 6.3.1.4.)

6.4.1.2.2 Mapping to physical resources

6.4.1.2.2.1 Precoding and mapping to physical resources if transform precoding is not enabled

The UE shall transmit phase-tracking reference signals only in the resource blocks used for the PUSCH, and only if the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are being used.

The PUSCH PT-RS shall be mapped to resource elements according to

$$\begin{bmatrix} a_{k,l}^{(p_0,\mu)} \\ \vdots \\ a_{k,l}^{(p_{\rho-1},\mu)} \end{bmatrix} = \beta_{\text{PT-RS}} W \begin{bmatrix} r^{(\tilde{p}_0)}(2n + k') \\ \vdots \\ r^{(\tilde{p}_{\upsilon-1})}(2n + k') \end{bmatrix}$$

$$k = \begin{cases} 4n + 2k' + \Delta & \text{configuration type 1} \\ 6n + k' + \Delta & \text{configuration type 2} \end{cases}$$

(3GPP TS 38.211 V16.8.0, § 7.4.1.2.)

7.4.1.2 Phase-tracking reference signals for PDSCH

7.4.1.2.1 Sequence generation

The phase-tracking reference signal for subcarrier k is given by

$$r_k = r(2m + k')$$

where $r(2m + k')$ is the demodulation reference signal given by clause 7.4.1.1.2 at position l_0 and subcarrier k

7.4.1.2.2 Mapping to physical resources

The UE shall assume phase-tracking reference signals being present only in the resource blocks used for the PDSCH, and only if the procedure in [6, TS 38.214] indicates phase-tracking reference signals being used.

If present, the UE shall assume the PDSCH PT-RS is scaled by a factor $\beta_{\text{PT-RS},i}$ to conform with the transmission power specified in clause 4.1 of [6, TS 38.214] and mapped to resource elements $(k, l)_{p,\mu}$ according to

$$a_{k,l}^{(p,\mu)} = \beta_{\text{PT-RS},i} r_k$$

(3GPP TS 38.211 V16.8.0, § 7.4.1.2.) Accordingly, on information and belief, the shared baseband processor in the Accused Products applies a single phase adjustment to each of the incoming digital baseband signals to jointly account for both beamforming phase rotation and carrier phase rotation of individual antenna elements, literally and/or under the doctrine of equivalents.

Jury Trial Demanded

26. Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Lionra requests a trial by jury of any issues so triable by right.

Prayer for Relief

Plaintiff Lionra respectfully requests the following relief from this Court:

A. A judgment in favor of Lionra that Defendant has infringed the ’141 patent and that the ’141 patent is valid, enforceable, and patent-eligible;

B. A judgment and order requiring Defendant to pay Lionra compensatory damages, costs, expenses, and pre- and post-judgment interest for its infringement of the ’141 patent, as provided under 35 U.S.C. § 284;

C. Any and all injunctive and/or equitable relief to which Lionra may be entitled including, but not limited to, ongoing royalties with respect to Defendant’s infringement of the ’141 patent;

D. A judgment and order requiring Defendant to provide an accounting and to pay supplemental damages to Lionra, including, without limitation, pre-judgment and post-judgment interest;

E. A finding that this case is exceptional under 35 U.S.C. § 285, and an award of Lionra's reasonable attorney's fees and costs; and

F. Any and all other relief to which Lionra may be entitled.

Dated: July 5, 2022

/s/ Reza Mirzaie

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ATTORNEYS FOR PLAINTIFF, LIONRA TECHNOLOGIES LIMITED

CERTIFICATE OF SERVICE

I hereby certify that all counsel of record are being served with a copy of the foregoing document via the Court's CM/ECF filing system on July 5, 2022.

/s/ Reza Mirzaie
Reza Mirzaie